

## Green Zia Analysis of Johnson Controls Northern New Mexico Paint Stripper Wastes

### Background

Johnson Controls Northern New Mexico (JCNNM) is the facility support subcontractor to the Los Alamos National Laboratory (the Laboratory), in Los Alamos, New Mexico. JCNNM operates and maintains the Laboratory facilities, equipment, property, grounds, infrastructure, and public and private roadways covering over 27,800 acres. All JCNNM work is conducted on behalf of the Laboratory and the Department of Energy (DOE).

JCNNM services include painting and paint stripping activities in support of facility maintenance, construction activities and utilities work, among others. During DOE Fiscal Years (FY) 1998 and 1999, JCNNM generated approximately 5525 kg of hazardous waste associated with painting and stripping operations. Further, JCNNM activities in support of Nuclear Materials Technology Division (NMT) operations generated approximately 1.05 m<sup>3</sup> of mixed transuranic (MTRU) and 5.25 m<sup>3</sup> of mixed low-level radioactive wastes (MLLW). As part of their commitments to pollution prevention (P2), NMT and JCNNM initiated an effort to identify material substitutes for the paint thinners and strippers used by JCNNM, with the goal of eliminating the hazardous chemical nature of the materials and their waste products. Working together, JCNNM and NMT personnel began a systematic process to evaluate and implement P2 opportunities for painting and stripping operations.

This paper presents the approach used by JCNNM and NMT to reduce pollution caused by painting and paint stripping activities. This approach utilizes the *New Mexico Green Zia Systems Analysis Tools* (Green Zia tools), as specified in Function Area 3 (Managerial Accomplishments) of Section B, Part II-1, Appendix F of the DOE/University of California contract (2000). The Green Zia analyses employed in this project were generally accomplished according to the New Mexico Green Zia Environmental Excellence Award Program guidance at <http://www.nmenv.state.nm.us>. This is one of three Green Zia analyses that JCNNM has completed to satisfy Goal 3 of Performance Measure 29, "Hazardous Waste Generation," in JCNNM's contract with the Laboratory.

During this analysis, JCNNM applied the following Green Zia tools:

- Process mapping of paint stripping activities at TA-55
- Identification and rank ordering of paint stripper substitutes and other P2 alternatives
- Root cause analysis identifying process steps that contribute chemical hazards to the wastes
- Activity-based costing analysis
- Consensus problem statement
- Generating material substitute options and other P2 alternatives
- Selecting appropriate option and/or alternative
- Implementing the selected option and/or alternative with a formal action plan

JCNNM and NMT have ongoing and formal P2 programs committed to reducing waste and environmental releases. The JCNNM P2 program is documented in a written plan (*The Waste Minimization/Pollution Prevention Program Plan for Calendar Years 1997 through 1999*, SPI 12-31-012) and P2 practices are incorporated into operating procedures, where appropriate. In

addition, Performance Measure 29 of JCNNM's contract with the Laboratory requires P2 activities, which are tied to the subcontract award fee. These documents express JCNNM's commitment to preventing waste at the source, while also recycling and minimizing waste that has not been prevented. In addition, Performance Measure 29 establishes numeric goals for reduction of wastes, requires tracking and reporting of progress toward meeting the goals, and provides incentives or rewards for waste reduction. Under JCNNM's P2 program, Department and line managers are challenged and required to incorporate P2 practices to the extent technically and economically feasible.

The NMT P2 program is documented in a written plan (*Waste Management*, TA55-SOP-539,R3.1). Further, Function Area 3 (Managerial Accomplishments) of Section B, Part II-1, Appendix F of the DOE/University of California contract (2000) requires the Laboratory to implement P2 activities as a condition of contract continuance. In addition, NMT has a formal training program for its waste generators and communicates P2 and waste minimization requirements via the course "Pollution Prevention and Waste Management." These documents and training programs reflect NMT's and the Laboratory's commitments to preventing waste at the source and facilitate NMT's incorporation of P2 practices into its operating procedures. In compliance with NMT's P2 program, Department and line managers are challenged and required to incorporate P2 practices to the extent technically and economically feasible.

### **Green Zia Paint Stripper Waste Team**

JCNNM and NMT formed a multi-disciplinary team to address painting and stripping wastes at TA-55. The team included personnel familiar with painting and stripping activities at TA-55, as well as those knowledgeable about JCNNM and NMT waste management, health and safety requirements. The following individuals were members of this team:

- Connie Gerth, NMT-7 Waste Management Coordinator, JCNNM-HENV/BEC;
- Robert Kyser, Safety Engineer, JCNNM-HSFT;
- Michael Lopez, Painter Foreman, JCNNM-FS07; and
- Jim Stanton, P2 Program Coordinator, JCNNM-HENV/BEC.

### **Statement of Problem**

NMT operations routinely involve radioactive materials. Occasionally, contamination events occur, in which radioactive particles are released into the air and then settle onto floors, walls and similar surfaces. Contamination that settles into crevices can be especially difficult to clean up. If routine decontamination processes cannot remove the radioactive material in the crevices, then the contaminated areas must be stripped and repainted.

Currently, JCNNM uses a methylene chloride-based stripper for contamination event cleanup activities. Methylene chloride is fast acting (typical bubble time is 1.5 hours) and can work on horizontal, vertical and overhead surfaces. However, methylene chloride poses a significant exposure risk to personnel, who must wear respirators while working with the paint stripper. Further, spent methylene chloride used for paint stripping is a listed hazardous waste, as are any materials contaminated by the spent stripper. Thus, the stripped paint, as well as any contaminated rags, disposable equipment and PPE are managed as MTRU or MLLW at considerable expense to the Laboratory and DOE Defense Programs (DOE-DP).

## The Challenge

From October 1997 to June 2000, JCNNM paint stripping activities generated approximately 1.05 m<sup>3</sup> of MTRU and 5.25 m<sup>3</sup> of MLLW for NMT. The Laboratory has published the following estimates for waste disposal costs: \$11.75 per kg of hazardous waste, \$58,000 per m<sup>3</sup> of MTRU and \$88,305 per m<sup>3</sup> of MLLW. Even though DOE-DP paid the majority of these costs in DOE FY 2000, wastes from painting and stripping activities still represent significant cost burdens on JCNNM and the Laboratory.

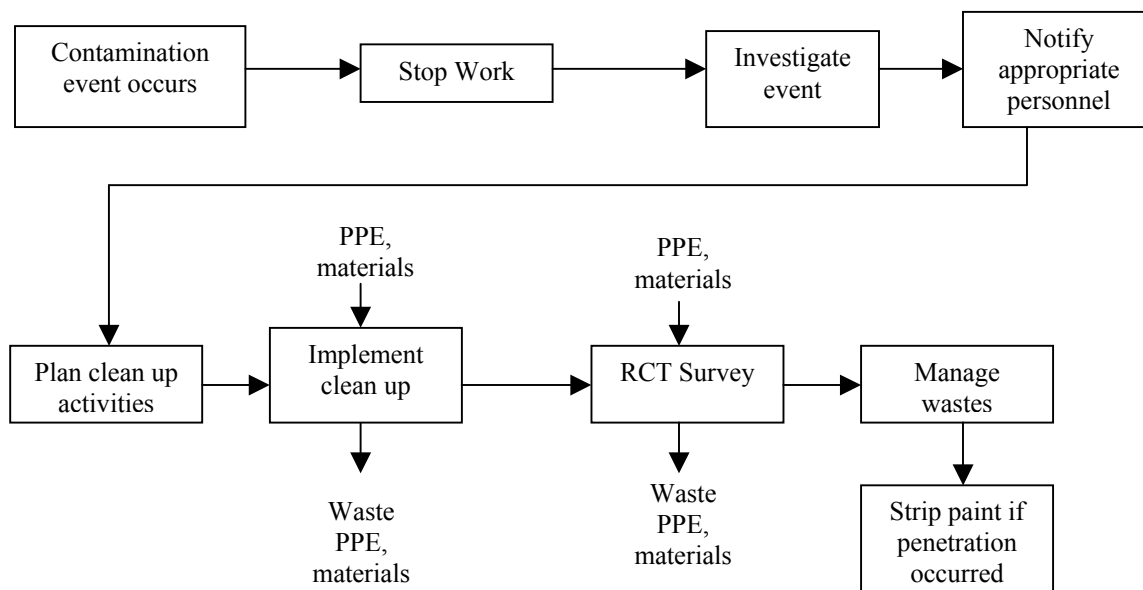
The goal of this project was to reduce the toxicity of the wastes generated by paint stripping activities, with the intention of eliminating the hazardous component of the MTRU and MLLW so that future wastes could be regulated as low-level radioactive waste only. Therefore, the challenge for this team was to identify an alternative paint stripper with the following characteristics:

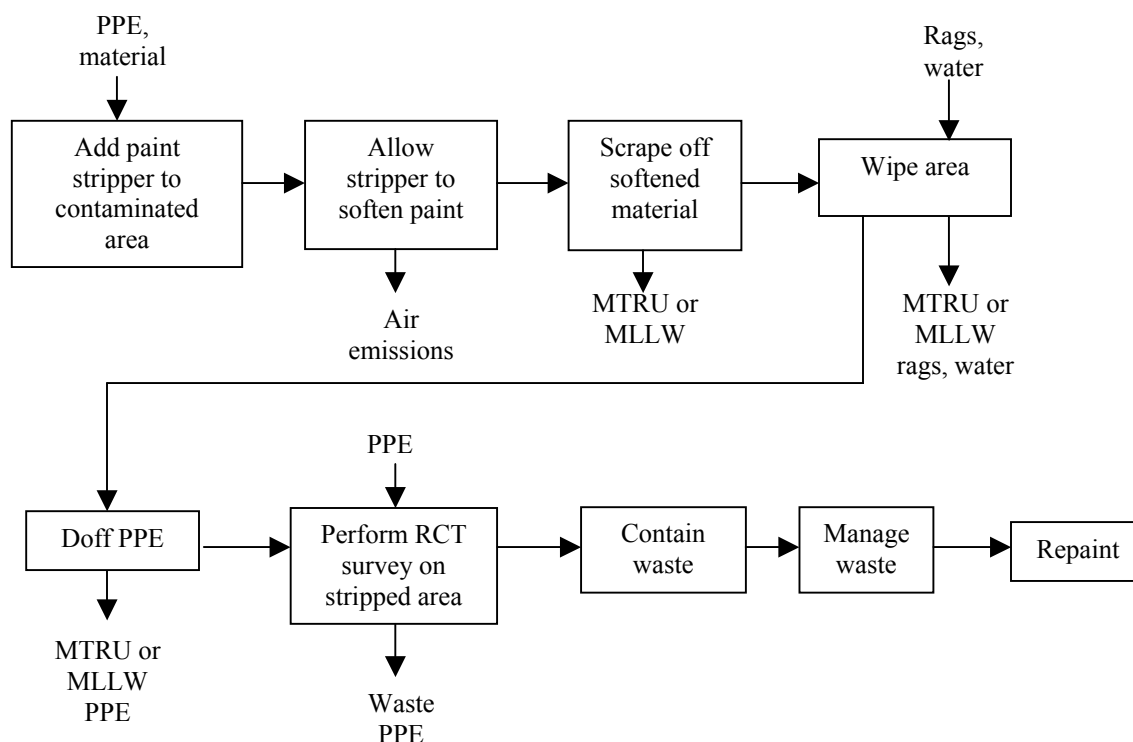
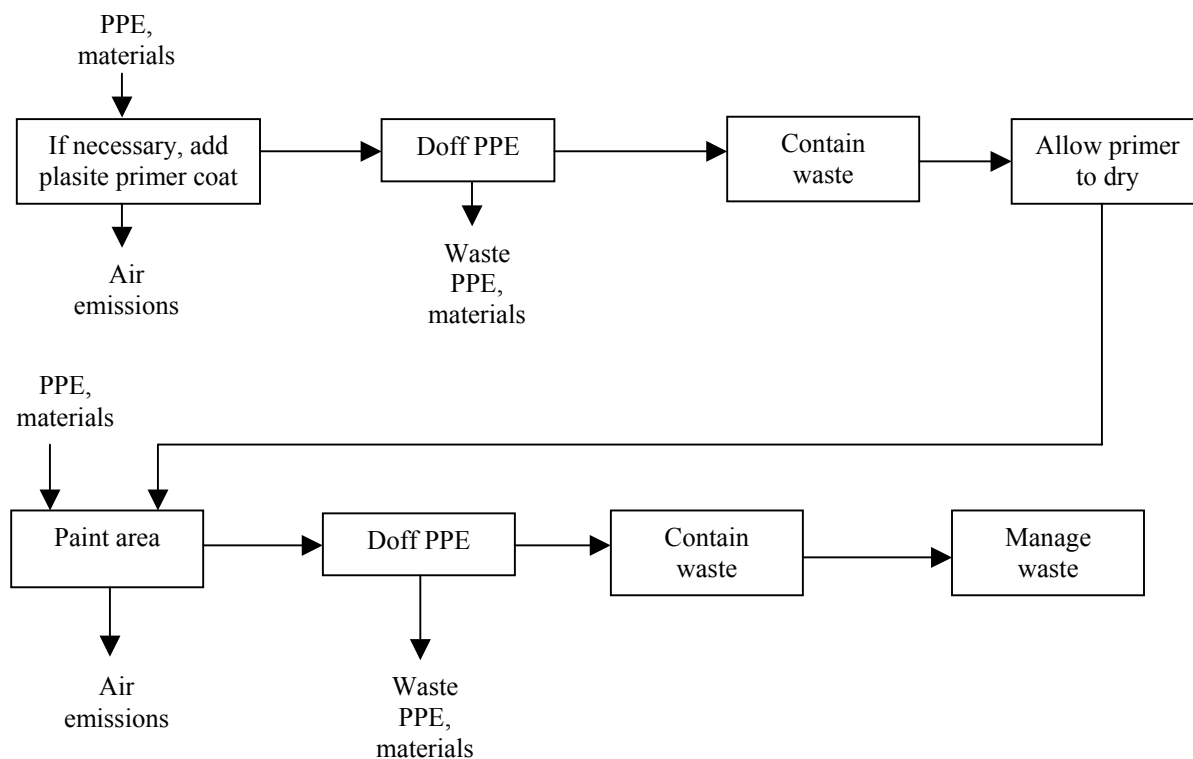
- Non-hazardous (i.e., eliminated personnel exposures and listed hazardous waste);
- Fast acting (i.e., bubble time of 1 to 2 hours); and
- Usable on horizontal, vertical and overhead surfaces.

## Process Characterization

The team prepared a series of process maps to illustrate paint stripping activities as they pertain to contamination event cleanup. As shown in Figures 1 through 3, this process generates PPE, rags, equipment and stripped materials that are both radioactive and hazardous wastes. Figure 2 shows the wastes and air emissions affected by the paint stripper chemical composition, while Figure 3 shows those affected by the plasite primer and paint chemical compositions.

**Figure 1. Detailed Process Map Illustrating TA-55 Contamination Event Response**



**Figure 2. Detailed Process Map Illustrating TA-55 Paint Stripping Operations****Figure 3. Detailed Process Map Illustrating TA-55 Repainting Operations**

### Activity-Based Costing

The team also completed an activity-based costing analysis to identify the costs associated with paint stripping and to estimate the potential cost impacts of using a non-hazardous stripper. Tables 1 and 2 summarize the results of the activity-based costing analysis and show that waste management is the largest cost associated with this process.

**Table 1. Summary of Paint Stripping Costs**

Item No.	Description	Current Costs			Estimated Savings		
		Estimated Cost per Cont. Event	Cont. Events per Year	Estimated Annual Cost	Cost Savings per Cont. Event	Annual Cost Savings	% ROI
1	Perform Paint Stripping	\$1,589.35	2	\$3,178.70	\$0.00	\$0.00	
2	Repaint the Cleaned Area	\$1,422.48	2	\$2,844.96	\$0.00	\$0.00	
3	Manage Wastes	\$10,585.11	2	\$21,170.22	\$4,960.39	\$9,920.78	
	<b>TOTALS</b>	<b>\$13,596.94</b>		<b>\$27,193.88</b>	<b>\$4,960.39</b>	<b>\$9,920.78</b>	
	<b>Cost of Implementing the Selected Alternatives</b>			<b>\$70,320.55</b>			<b>22.37</b>

**Table 2. Item Category Summary Table**

Item No.	Description	Current Costs			Estimated Savings		
		Estimated Cost per Cont. Event	Cont. Events per Year	Estimated Annual Cost	Cost Savings per Cont. Event	Annual Cost Savings	% ROI
1	Labor	\$2,282.00	2	\$4,564.00	\$0.00	\$0.00	
2	Materials	\$1,089.83	2	\$2,179.66	\$0.00	\$0.00	
3	Fees	\$10,225.11	2	\$20,450.22	\$4,960.39	\$9,920.78	
	<b>TOTALS</b>	<b>\$13,596.94</b>		<b>\$27,193.88</b>	<b>\$4,960.39</b>	<b>\$9,920.78</b>	
	<b>Cost of Implementing the Selected Alternatives</b>			<b>\$70,320.55</b>			<b>22.37</b>

### Root Cause Analysis

The team determined that all MTRU and MLLW from TA-55 paint stripping activities were caused by contamination events where radioactive particles settled into crevices. Secondary wastes are caused by the chemical compositions of the paints, strippers and primers and implementation of PPE requirements for each activity. Chemical vapors are emitted into the air

by a variety of activities. Table 3 summarizes the team's findings on the root causes of pollution associated with painting and stripping at TA-55.

**Table 3. Root Causes by Waste Type**

<b>Waste Type</b>	<b>Root Cause</b>
All MTRU & MLLW	Settling of radioactive particles from a contamination event
Hazardous component of MTRU, MLLW & hazardous stripper waste	Stripper, paint & primer chemical compositions
PPE	Stripper, paint & primer chemical compositions, associated exposure hazards, site exposure hazards
Waste Rags	Wiping area after stripping, chipping
Chemical air emissions	Stripping, adding primer, & repainting

A primary concern of the team was that methylene chloride caused the stripper wastes to be listed hazardous wastes (F002) as described at 40 CFR §§261.30 and 261.31. Any material (such as PPE or rags) contaminated by a listed hazardous waste is itself a listed hazardous waste unless decontaminated. This situation acts to increase the MTRU and MLLW generated by paint stripping operations.

While the methylene chloride caused the stripper wastes to be listed hazardous waste, substituting a non-hazardous stripper may not eliminate the hazardous component of all the MTRU or MLLW generated. The primer that has been historically used at TA-55 contained 30 percent strontium chromate and, when stripped, may cause the stripped material to be characteristically hazardous. However, for PPE and equipment, the hazardous component of the MTRU and MLLW is most likely due solely to contamination by a listed hazardous waste. This suggests that paint stripper substitution would have some P2 effect, but will not completely eliminate the hazardous component of the wastes.

### **Generating Process Alternatives**

The team identified two potential substitutes for methylene chloride: Citri-strip and Organo-Strip. These are non-hazardous, citrus-based paint strippers and are commonly available. Also, the process map suggested the following potential alternatives for addressing paint stripper wastes:

- 1) Prevent and mitigate contamination events. This would eliminate the need to strip paint as part of the cleanup process.
- 2) Use removable surface coatings in areas where radioactive materials are likely to be deposit. When contamination events do occur, easily removable surface coatings could prevent deposition in crevices. Cleanup crews would peel the contaminated coatings off various surfaces and dispose of them as low-level radioactive wastes, rather than as MTRU or MLLW. Removal and reapplication could be performed quickly, would not require extra PPE or generate air emissions or worker exposures

- 3) Eliminate the use of primers inside TA-55 buildings. This would eliminate the air emissions, PPE and other wastes generated by applying the primer. Also, because it eliminates a step, NMT down time would be reduced.
- 4) Segregate paint stripping wastes from repainting wastes. Stripping activities account for all of the hazardous waste generated during cleanup activities. Physically separating stripping wastes from repainting wastes will ensure that repainting wastes are managed as radioactive wastes only, rather than MTRU or MLLW.
- 5) Stop stripping paint at TA-55. This would eliminate all the emissions and wastes generated by paint stripping. However, radioactive contamination would not be effectively cleaned up.

### Selecting an Alternative

Table 3 presents a comparison of Citri-Strip and Organo-Strip.

**Table 3: Characteristic Comparison of Citri-Strip and Organo-Strip**

Characteristic	Product	
	Citri-Strip	Organo-Strip
Bubble time	8 - 12 hours	2 hours
Usable on vertical & overhead surfaces	No	Yes
Non-hazardous	Yes	Yes
Available through JIT	Yes	No

Because Organo-Strip met all of the pre-determined characteristics, the team chose to pursue using it rather than Citri-Strip. The team felt that Organo-Strip would be useful to JCNNM painters outside TA-55 as well and committed to investigating whether JCNNM could use Organo-Strip at other Laboratory facilities. Finally, the team chose to investigate the following alternatives to further eliminate the wastes associated with paint stripping activities:

- 1) Prevent and mitigate contamination events.
- 2) Use removable surface coatings in areas where radioactive particles are likely to deposit.
- 3) Segregate paint stripping wastes from repainting wastes.
- 4) Eliminate the use of primers inside TA-55 buildings.

### Implementing the Alternative

The team prepared an action plan for implementing the selected alternatives. However, NMT has final authority for determining what materials may be used at TA-55, and JCNNM has final authority for setting project funding priorities. If the project is approved, full implementation will be coordinated through the project team, which will meet quarterly to assess progress, identify and implement lessons learned, and quantify the action plan's specified metrics. Upon approval to begin full implementation, an independent person will assess implementation progress annually and help the team identify necessary plan modifications.

The ultimate goal of implementing this action plan would be to reduce NMT's paint related MTRU and MLLW generation rate by 50 percent over FY 1999 levels by the end of FY 2002.

**Action Plan****Deadline: TBD****Responsible Party: Jim Stanton****Goal #1: Substitute Organo Strip for Methylene Chloride at TA-55 (M. Lopez)****Objectives:**

- Ensure that Organo-Strip gets placed on the JIT list.
- Initiate procedural changes and documentation required for using Organo-Strip in place of methylene chloride.
- Begin using Organo-Strip and characterize the stripped material.

**Goal #2: Eliminate the use of primers inside TA-55 (M. Lopez)****Objectives:**

- Investigate whether primers are necessary for indoor use of plasite paint.
- If primers are not necessary, initiate the procedural changes and documentation required to stop using primers inside TA-55 buildings.
- Stop using primers.

**Goal #3: Support and enhance ongoing efforts to prevent contamination events at TA-55 (C. Gerth, M. Lopez, and B. Kyser)****Goal #4: Investigate using removable surface coatings in areas where radioactive particles are likely to deposit (C. Gerth, J. Stanton)****Objectives:**

- Identify areas for potential implementation.
- Identify removable coatings that may be used at TA-55.
- Perform a pilot project.
- Report findings and make recommendations.

**Goal #5: Segregate paint stripping wastes from repainting wastes (M. Lopez, C. Gerth)****Objectives:**

- Ensure appropriate waste segregation is addressed in paint stripping procedures.
- Develop a simple, NMT-approved waste management plan for painters to follow during stripping and repainting activities.
- Establish strong lines of communication between painters and NMT waste management coordinators.

**Goal #6: Investigate substituting Organo Strip for other JCNNM strippers (J. Stanton)****Objectives:**

- Contact core and zone personnel responsible for paint stripper use and procurement.
- With core and zone personnel, determine if Organo-Strip is a legitimate option for JCNNM operations outside TA-55.
- Build consensus and begin using Organo-Strip company-wide.